EVALUATION OF THE EFFECTS OF MOVE+ VS STAND+ INTERVENTIONS IN THE WORKPLACE ON SNACKING

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Abstract

Introduction: Obesity is a growing epidemic in the United States with two out of every three adults age 20 or older being overweight or obese. Obesity is linked to an increased risk for cardiovascular disease, pulmonary disease, cancer, and osteoarticular diseases. Snacking has been identified as a dietary pattern that could contribute to the prevalence of overweight and obesity. Snacking patterns can be influenced by the environment such as the workplace. Research on sedentary interventions in the workplace has been conducted, but there is currently very little data on the impact of sedentary interventions on snacking. The purpose of this study is to determine the effect of workplace sedentary interventions on diet, more specifically snacking, and to give more information on the nutritional value of snacking.

Material/Methods: The Move+ and the Stand+ interventions were implemented into 24 worksites in Phoenix, Arizona and Minneapolis/St. Paul, Minnesota. Dietary data was collected through the ASA24 Automated Self-administered 24-hour Recall at timepoints 0 months, 3 months, and 12 months. Snacking data was extracted from the ASA 24 site and separated into snacks including plain water and snacks excluding plain water. Mean outcomes were calculated for kilocalories, protein, total fat, carbohydrates, sugar, iron, vitamin D, and cholesterol on a per snack basis for the Move+ and Stand+ groups. A linear mixed model was used to compare the Move+ vs Stand+ snacking outcomes over timepoints 0, 3, and 12.

Results: There was a significant difference in kilocalories and total fat between Move+ timepoints 3 months and 12 months in snacks excluding plain water, but this was determined to not be clinically significant in terms of weight change or health benefits. There was no other significant difference found in mean outcomes or the linear mixed model for Move+ and Stand+ groups. By discussing Recommended Dietary Allowance values, snacks were found to contribute between 5%-15% to protein and carbohydrate RDAs and provide iron intake. With an average individual eating 2.2 snacks per day, participants were eating between 267.0 kcals to 322.9 kcals in snacks per day.

Conclusion: Although the sedentary interventions did not significantly impact snacking over time, these interventions do have the potential to burn a significant amount of calories over time as well as fight sedentary behaviors. Overall, this study provides needed data on snacking patterns in the American workforce.

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Introduction and Significance

Obesity has become an epidemic in the United States. Since the early 1960s, the prevalence of obesity has almost tripled, rising from 13.4% to 35.6%.[1] Today, about two out of every three US adults age 20 or older are overweight or obese.[1] Among different ethnic groups, overweight and obesity impacts more than 78.8% of Hispanics, 76.7% of African Americans, and 66.7% of Caucasians.[1] Being overweight or obese has been linked to many health problems. It increases the risk for cardiovascular disease, pulmonary disease, cancer, and osteoarticular diseases.[2] Obesity has also been associated with type 2 diabetes, with over 80% of people with type 2 diabetes being overweight or obese.[1] Obesity not only takes a toll on health, but also has significant economic impact. Individual health care and medication costs rise by 36% and 77%, respectively, due to obesity.[2] Obesity leads to an average increase of $395 per year and overweight leads to an average increase of $125 per year for individual inpatient and ambulatory care.[2]

The high prevalence, negative health outcomes, and cost of overweight and obesity in the US population have led to investigations on the association between specific dietary patterns and weight status. Snacking has been identified as a dietary pattern that could contribute to overweight and obesity.[3] The change in the pattern of snacking could be linked to US weight rise.[3] Over the past 30 years, the snacking of adults has transformed.[3] Between 1997-1998 and 2007-2008, the mean frequency of snacking has increased from 1.0 to 2.2 snacks per day and the percentage of adults snacking during the day has increased from 59% to 90%.[3] In addition, 73% of adults use to snack only once or not at all whereas 65% of adults are now snacking two or more times per day.[3]

Higher snacking frequency is associated with higher total calorie intake, which could contribute to obesity.[3,4] Energy content and density of snacks have increased from the late 1970s to late 1990s.[4,5] The daily energy load from main meals has remained relatively constant whereas the energy from snacks has risen by 261 kcal for men and by 160 kcal for women.[5] The mean daily energy density has also risen from 1.05 kcal to 1.32 kcal.[5] Snack foods are often lower in fat and higher in carbohydrates.[5] Snacking also contributes higher proportions of alcohol and total sugar intake levels per day in adults.[4] In the US, popular snack choices include cakes, cookies, and savory foods such as pretzels, potato chips, and crackers.[4,6] Based on the 2007-2008 What We Eat in America (WWEIA) survey, snacking is contributing a daily average of 586 calories for men and 421 calories for women.[3] Although snacks are contributing calories, they are providing little nutritional value.[4,5,6]

Dietary patterns can be influenced by lifestyle and environmental factors. Sedentary activities such as watching TV are associated with reduced energy expenditure and unhealthy eating patterns such as increased snacking.[7] On average, adults spend 7.5 hours per day being sedentary.[8] Workplace sitting contributes substantially to an individual's sedentary time.[8,9] At work, the average American spends 70-80% of their time sitting at a desk, in meetings, or on the phone.[9] The adverse health effects of sedentary lifestyle such as elevated risk of type 2 diabetes, cardiovascular disease, obesity, and premature mortality have prompted inventions, specifically to target a reduction in sitting time in high-risk settings like the workplace.[10]

Implementing workplace interventions with organizational, environmental, and individual support has become a public health focus in recent years.[10] Improvements in blood lipids, mood state, and upper back and neck pain have been noted following previous intervention studies.[11,12] The studies are limited due to small sample size, short follow-up, and non-randomized designs and little research is currently available on the impact of workplace interventions on dietary habits.

While there has been previous research on workplace interventions, the studies have been limited and there is little data analyzing the impact of interventions on diet. Therefore, this large, long-term group-randomized trial provides new insight into the effect of workplace interventions on diet, more specifically snacking. The goal of this research is to provide information on the impact of worksite interventions as well as improve worker health. We hypothesized that employees 18 years or older participating in the 12-month Stand+ intervention will show a greater decrease in snacking compared to the 12-month Move+ intervention.

Material and Methods

Study Population and Design

Worksites in Arizona and Minnesota were recruited that met the inclusion criteria and then individual employees were recruited within each worksite. The inclusion criteria are as follows:

Worksite-level Inclusion Criteria	**Member-level Inclusion Criteria**
-Small: Small to moderate size worksites (20-60 employees) -Schedule: >80% of employees full-time -Occupation: Seated office work, primarily computer- and telephone-based work, little movement or walking -Wellness environment: Not currently undergoing a wellness program aims at increasingly activity at work -Workstations: Willing to have sit-stand workstations installed at worksite -Willing to be randomized to either intervention condition	-Age: 18 years and older -Health Status: Generally good health and able to safely increase light-intensity physical activity (LPA) and reduce sitting -Employment Status: Full-time (35+ hours/week) -Occupation: Any sedentary job, sitting most of the day, little standing or walking -Workstation: Traditional sitting desk; willing to have sit-stand workstation installed at desk

Twenty-four worksites in Phoenix, Arizona and Minneapolis/St. Paul, Minnesota with an average of 30 participants per worksite were recruited. The worksites were primarily within administrative areas of academia, government, and healthcare, which mainly consist of computer- and telephone-based work.

Worksite Eligibility

A worksite was a unit of randomization and analysis in the study. The recruited worksites were mostly isolated units with little to no physical interaction with other worksites. Worksites were screened and excluded from the study if found to have medium to high interaction with other sites. High interaction sites could have already had high levels of standing and moving and their inclusion could have contaminated effects of our intervention.

Interventions

The twenty-four worksites were randomly assigned to one of the interventions: *MOVE+ or STAND+*. Interventions included individual, social, and environmental components. The two interventions are as described below.

MOVE+ Intervention

The *MOVE* intervention focused on gaining 30 minutes or more of light-physical activity (LPA) during the workday. At the beginning of the study, participants were given access to a free online ergonomic self-assessment tool designed by the University of Minnesota. Throughout the study, each worksite had wellness/ergonomic professional who worked with us and were available to answer participant questions. For the individual level, email-based materials were sent out weekly with tips, advice, and education to accumulate more LPA during the day such as taking the stairs and office walking routes. Participants were encouraged to set daily goals to increase type and frequency of LPAs and received relapse-prevention training to encourage them to achieve their goal. For the social level, participants with high accumulation of LPA were recognized and awarded a prize based on the workplace preference. At the environmental level, workplaces were restructured by moving printers, trashcans, and kitchen supplies out of individual workspaces to a central location. Signs were placed throughout each site to encourage LPA through stair use or encouragement of walking. For the organization level, the worksite manager issued an initial letter of support for the intervention and new practices were implemented in line with the intervention.

STAND+ Intervention

The *STAND+* intervention focused on gaining 30 minutes or more of light-physical activity (LPA) and gradually spending 50% of at-desk time standing during the workday. It included the *MOVE+* intervention components and the addition of sit-stand workstations. The workstations were bought from *Ergotron,* Inc and included the Ergotrom Workfit-T and Workfit-S sit-stand workstations. Trained research staff installed the workstations. At the beginning of the study, participants were given a free online ergonomic self-assessment tool like *MOVE+* participants and additional instruction on the use of the sit-stand workstations. Participants were instructed to begin standing in 15-20 minute increments to add to 1 h/day and progressively increase by 15-20 minutes per day until they were able to spend 50% of at-desk time standing.

Data Collection

Data collection occurred at timepoints 0 months (baseline), 3 months, and 12 months. Self-reported nutrient intake was collected using ASA24 Automated Self-administered 24-hour Recall. At timepoint 0, participants were assigned a unique ASA 24 username that was matched with their participant ID. The ASA 24 username was used by the participants to log in to complete each recall and allowed us to analyze dietary intake data for each participant and worksite. The participants received an ASA 24 recall on a random day of each timepoint. Each survey took 20-30 minutes to complete. The ASA 24 website helped guide the participants through each recall. The participants entered nutrient intake from the previous day from midnight to midnight. Employees reported eating occasions and time of meal as well as optional components such as place of meal, if the meal was eaten alone, and TV or computer use during the meal. Participants not only marked the food and drinks from each meal, but also completed detailed questions about portion size, meal preparation, and other additions such as amount of salt and pepper added. Once completing the recall, participants did not receive feedback, but the 24 hour recall data was stored in the ASA 24 researcher website and was pulled at the completion of the study for analysis.

Data Analysis

The data was separated into two separate analysis pools. The ASA 24 system used for data collection allowed participants to report solid snack foods but also beverages. Beverages included a variety of liquids including water in a glass or a water bottle as a snack. The choice was made to do a separate analysis without water to get more information on nutritional values for non-water snacks. Therefore, the data analysis reflects snacks including plain water as well as snacks excluding plain water. The two separate analyses were conducted to better evaluate the nutrient values of solid snacks as well as calorie-containing beverages.

Statistical Methods

Demographic information between the Move+ group and the Stand+ group were reported as means, standard deviations for continuous variables and frequencies, proportions for categorical variables. The Wilcoxon Rank Sum was used to compare the continuous variables between the intervention groups while Chi-Squared analysis/Fisher's Exact test was used to compare categorical variables.

Mean outcomes were calculated for snacks including and excluding water for the Move+ and Stand+ groups. The mean outcomes were included kilocalories, protein, total fat, carbohydrates, sugar, iron, vitamin D, and cholesterol on a per snack basis. The mean values per snack were reported for timepoints 0, 3, and 12. The Wilcoxon Signed-Rank test was used to analyze the significant difference between each timepoint for the Move+ group and the Stand+ group, respectively.

Finally, linear mixed models were used to compare the Move+ vs Stand+ snacking outcomes over time points 0, 3, and 12. The snacking outcomes included kilocalories, protein, total fat, carbohydrates, sugar, iron, vitamin D, and cholesterol. All p-values were 2-sided and $p<0.05$ was considered statistically significant. All data analyses were conducted using STATA version 14 (College Station, TX).

Results

Table I reviews the demographics of men and women participants in this study. The average age (standard deviation) of the Move+ and Stand+ participants was 43.3 (10.8) and 45.6 (11.4), respectively. The percentage of women in the Move+ group was 36.6% compared to the Stand+ group with 16.4%. The Move+ group was found to be 78.2% Non-Hispanic white and the Stand+ group was 70.3% Non-Hispanic white. The majority of participants in the Move+ and Stand+ groups had a Bachelor's degree with 40.8% and 27.5%, respectively. The next highest level of education was a Masters degree or higher with 37.1% and 27.3% in the Move+ and Stand+ groups. The most common income range was $100,000-149,999 for each group. The highest percentage of participants were married or partnered with 63.6% in the Move+ group and 59.1% in the Stand+ group. The most common location while eating snack was home in both groups followed by work. There was several characteristics that were found to be statistically different between the Move+ and Stand+ groups, including age, gender, marital status, and eating location.

Table 2 represents the mean outcomes Stand+ and Move+ groups including water snacks. The mean kilocalories of snacks including water for the Stand+ group were 127.3 (SD=160.4) at baseline, 106.6 (SD=2.74) at 3 months, and 130.2 (SD=160.3) at 12 months. The mean kilocalories of snacks including water for the Move+ group were 123.3 (SD=131.8) at baseline, 124.3 (SD=115.7) at 3 months, and 121.3 (SD=126.4) at 12 months. The average number of kilocalories per snack in the Stand+ group increased by 1.1 kcal between timepoints 0 months and 3 months and decreased by 3.1 kcal between 3 months and 12 months. No statistical significance of kilocalories was found between each timepoint in the Stand+ group. The average number of kilocalories per snack in the Move+ group decreased by 20.7 kcal between 0 months and 3 months and increased by 23.6 kcal between 3 months and 12 months. No statistical significance of kilocalories was found between each timepoint in the Move+ group.

Table 2 also shows information regarding macronutrients for Stand+ and Move+ groups including water snacks. Macronutrients include protein, total fat, and carbohydrates. The Stand+ average protein increased by 0.16 g between 0 months and 3 months and decreased 0.04 g between 3 months and 12 months. The Move+ average protein decreased 1.15 g from 0 months to 3 months and increased 1.44 g from 3 months to 12 months. The mean total fat for the Stand+ group rose by 0.38 g from 0 months to 3 months and reduced by 0.77 g between 3 months and 12 months. Mean total fat decreased by 1.52 g between 0 months and 3 months and increased by 0.85 g between 3 months and 12 months. The mean carbohydrate value of snacks including water increased by 0.7 g between 0 months and 12 months in the Stand+ group and decreased by 2.8 g in the Move+ group between 0 months and 12 months. There was no significant difference in the mean values of macronutrients between timepoints 0 months, 3 months, and 12 months. There was also no significant difference in mean value of sugar, iron, vitamin D, or cholesterol over the study timepoints.

Table 3 represents the linear mixed model analysis of the Stand+ and Move+ groups including water snacks. Overall, the mean kilocalories and protein was 0.03% and 10% lower, respectively, in the Stand+ group compared to the Move+ group. The total fat was 34% lower and the total carbohydrate value was 1% higher in the Stand+ group. No statistical significance was found in the linear mixed model comparing macronutrients in the Move+ group vs. Stand+ group over 0 months, 3 months, and 12 months. Overall, there was 17% less iron and 16% less vitamin D in the Stand+ group. There was no statistical significance in the linear mixed model comparing sugar, iron, vitamin D, and cholesterol in the Move+ group vs. Stand+ group over 0 months, 3 months, and 12 months.

To further analyze snacking data, snacks classified as water were removed and remaining snacks were analyzed. Table 4 displays represents the mean outcomes Stand+ and Move+ groups excluding water snacks. The mean kilocalories of snacks excluding water for the Stand+ group were 152.1 (SD=164.3) at baseline, 131.5 (SD=119.1) at 3 months, and 156.7 (SD=163.7) at 12 months. The mean kilocalories of snacks excluding water for the Move+ group were 150.5 (SD=130.8) at baseline, 145.1 (SD=112.3) at 3 months, and 147.6 (SD=124.7) at 12 months. The mean kilocalories per snack of the Move+ group increased 2.5 kcal from 3 months to 12 months, which was statistically significant (p=0.05). The mean kilocalories per snack of the Stand+ group decreased 16.6 kcal from baseline to 3 months and increased 25.2 calories from 3 months to 12 months. No statistical significance of mean kilocalories was found between each timepoint in the Stand+ group.

Table 4 also provides information about macronutrients as well as sugar, iron, vitamin D, and cholesterol for snacks excluding water. The average protein per snack in the Move+ group increased 0.03 g between 0 months and 3 months and increased 0.07 g from 3 months to 12 months. The average protein per snack in the Stand+ group decreased 1.29 g between baseline and 3 months and increased 1.67 g between 3 months and 12 months. The total fat for the Move+ group decreased by 0.66 g between 3 months and 12 months, which was found to be statistically significant (p=0.02). The total fat for the Stand+ group decreased 1.65 g from baseline to 3 months and increased 0.9 g from 3 months to 12 months. The mean carbohydrate value per snack in the Move+ group decreased 1.1 g from baseline to 3 months and increased 1.8 g from 3 months to 12 months. The mean carbohydrate value per snack in the Stand+ group decreased 3.2 g from 0 months to 12 months (p=0.25). The amount of sugar per snack in the Move+ group increased 0.6 g 0 months to 12 months and the amount of sugar per snack in the Stand+ group decreased 3.03 g from 0 months to 12 months. The amount of iron per snack in the Move+ group decreased 0.11 mg from baseline to 12 months (p=0.06). There was also no significant difference in mean value of sugar, iron, vitamin D, or cholesterol over the study timepoints.

Table 5 represents the linear mixed model analysis of the Move+ and Stand+ groups excluding water snacks. The mean kilocalories for snacks excluding water for the Stand+ group was 0.03% higher than the Move+ group. The Stand+ group also had higher mean protein (11%) and total fat (52%). Mean carbohydrate level of snacks excluding water was 0.01% higher in the Move+ group compared to the Stand+ group. No statistical significance was found in the linear mixed model comparing macronutrients in the Move+ group vs. Stand+ group over 0 months, 3 months, and 12 months. There was 4% more sugar, 21% more iron, and 19% more Vitamin D in the Stand+ snacks. There was no statistical significance in the linear mixed model comparing sugar, iron, vitamin D, and cholesterol in the Move+ group vs. Stand+ group over 0 months, 3 months, and 12 months.

Table 1: Demographics

Variables	Move N=277	Stand N=357	P-value
Age, years, (mean, SD)	43.3 (10.8)	45.6 (11.4)	0.009
Gender (Female, %)	101 (36.6)	58 (16.4)	<0.001
Race (Non-Hispanic Whites, %)	205 (78.2)	239 (70.3)	0.03
Education (n, %)			
< High School			
GED	4 (1.52)	4 (1.17)	
High School Diploma	11 (4.17)	10 (2.93)	<0.001
Some College	34 (12.9)	70 (20.5)	
Associate's Degree	9 (3.41)	36 (10.6)	
Bachelor's Degree	108 (40.8)	128 (37.5)	
Masters or Higher	98 (37.1)	93 (27.3)	
Income (n, %)			
0-49999	39 (15.7)	47 (15.3)	
50000 – 74999	42 (16.9)	70 (22.7)	
75000 – 99999	45 (18.2)	53 (17.2)	0.18
100000 – 149999	52 (20.9)	78 (25.3)	
150000 – 199999	29 (11.7)	28 (9.09)	
>200000	32 (12.9)	27 (8.77)	
Marital Status (n, %)			
Single, Never Married	64 (24.5)	73 (21.4)	0.04
Married or Partnered	166 (63.6)	202 (59.1)	
Separated/Divorced/widowed	31 (11.9)	67 (19.6)	
Location: Respondent's location while eating the meal (n, %)			
Home			
Fast Food Restaurant	52 (54.7)	61 (47.7)	
Other Restaurant		3 (2.34)	
Cafeteria	1 (1.05)	2 (1.56)	
Bar or Tavern	1 (1.05)		0.09
Work		1 (0.78)	
Care	38 (40.0)	46 (35.9)	
Sports Venue (entertainment)		5 (3.91)	
Some Place Else		5 (3.91)	
Don't Know	3 (3.16)	5 (3.91)	
Recall Status (Complete, %)	183 (91.0)	248 (91.5)	0.65

Table 2: Mean Outcomes Move+ and Stand+ Groups Including Plain Water

Outcomes	Baseline (Mean, SD)	3 Months (Mean, SD)	p-value[1]	12 Months (Mean, SD)	p-value[2]	p-value[3]
Kcal						
Move	123.3 (131.8)	124.3 (115.7)	0.32	121.3 (126.4)	0.37	0.18
Stand	127.3 (160.4)	106.6 (2.74)	0.25	130.2 (160.3)	0.63	0.44
Protein (g)						
Move	2.75 (3.94)	2.91 (4.09)	0.69	2.84 (4.01)	0.29	0.83
Stand	3.28 (5.82)	2.13 (2.74)	0.53	3.57 (7.35)	0.9	0.38
Total Fat (g)						
Move	5.32 (7.99)	5.70 (7.44)	0.71	4.93 (7.89)	0.7	0.14
Stand	5.67 (11.2)	4.15 (5.94)	0.84	5.00 (8.10)	0.43	0.41
Carbohydrates (g)						
Move	16.1 (18.2)	15.9 (15.8)	0.32	16.8 (17.6)	0.4	0.94
Stand	16.5 (21.8)	15.8 (18.3)	0.4	13.7 (13.4)	0.49	0.58
Sugar (g)						
Move	9.13 (14.4)	9.85 (13.1)	0.4	9.57 (13.1)	0.38	0.95
Stand	9.50 (17.7)	7.41 (11.6)	0.09	6.96 (8.99)	0.59	0.76
Iron (mg)						
Move	0.71 (1.26)	0.64 (1.18)	0.78	0.69 (1.59)	0.28	0.95
Stand	.0.79 (1.59)	0.61 (0.87)	0.86	0.55 (0.67)	0.58	0.58
Vitamin D (mcg)						
Move	0.13 (0.47)	0.12 (0.47)	0.89	0.21 (0.69)	0.22	0.43
Stand	0.15 (0.63)	0.04 (0.14)	0.85	0.11 (0.45)	0.8	0.72
Cholesterol (mg)						
Move	5.99 (21.9)	8.10 (23.9)	0.73	7.65 (37.5)	0.48	0.37
Stand	4.19 (10.7)	4.69 (12.4)	0.99	5.82 (19.8)	0.9	0.74

[1]Wilcoxon Signed Rank to compare baseline to 3 months.

[2] Wilcoxon Signed Rank to compare baseline to 12 months.

[3] Wilcoxon Signed Rank to compare 3 months to 12 months.

Table 3:Linear Mixed Model Analysis of Stand+ and Move+ Groups Including Plain Water

Outcomes						
	Kcal		Protein		Total Fat	
	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value
Intervention Group						
Move	REF		REF		REF	
Stand	0.97 (0.71, 1.32)	0.86	0.90 (0.58, 1.41)	0.65	0.66 (0.80, 1.41)	0.11
Time Point						
0	REF		REF		REF	
3	0.95, 0.68, 1.33)	0.79	0.83 (0.53, 1.30)	0.42	0.80 (0.45, 1.41)	0.44
12	0.86 (0362, 1.25)	0.49	0.74 (0.46, 1.19)	0.21	0.76 (0.41, 1.38)	0.36

	Carbohydrates		Sugar		Iron	
	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value
Intervention Group						
Move	REF		REF		REF	
Stand	1.01 (0.71, 1.42)	0.97	0.96 (0.58, 1.58)	0.87	0.83 (0.57, 1.18)	0.29
Time Point						
0	REF		REF		REF	
3	1.31 (0.89, 1.93)	0.16	0.99 (0.56, 1.76)	0.77	1.20 (0.79, 1.83)	0.38
12	0.84 (0.56, 1.27)	0.41	0.98 (0.52, 1.86)	0.97	0.88 (0.56, 1.37)	0.58

	Vitamin D		Cholesterol	
	exp(Beta) (95% CI)	P-value	exp(Beta) 95% CI)	P-value
Intervention Group				
Move	REF		REF	
Stand	0.84 (0.34, 2.08)	0.71	1.04 (0.51, 2.10)	0.92
Time Point				
0	REF		REF	
3	1.75 (0.55, 5.51)	0.33	1.47 (0.60, 3.56)	0.38
12	0.95 (0.38, 2.40)	0.92	0.73 (0.32, 1.66)	0.46

Table 4: Mean Outcomes Stand+ and Move+ Groups Excluding Plain Water

Outcomes	Baseline (Mean, SD)	3 Months (Mean, SD)	p-value[1]	12 Months (Mean, SD)	p-value[2]	p-value[3]
Kcal						
Move	150.5 (130.8)	145.1 (112.3)	0.8	147.6 (124.7)	0.11	0.05
Stand	152.1 (164.3)	131.5 (119.1)	0.3	156.7 (163.7)	0.91	0.43
Protein (g)						
Move	3.36 (4.11)	3.39 (4.23)	0.72	3.46 (4.17)	0.24	0.74
Stand	3.92 (6.16)	2.63 (2.83)	0.52	4.30 (7.89)	0.91	0.68
Total Fat (g)						
Move	6.50 (8.39)	6.66 (7.63)	0.82	6.00 (8.32)	0.54	0.02
Stand	6.77 (11.9)	5.12 (6.21)	0.79	6.02 (8.54)	0.31	0.91
Carbohydrates (g)						
Move	19.7 (18.2)	18.6 (15.5)	0.55	20.4 (17.4)	0.11	0.89
Stand	19.7 (22.5)	19.5 (18.5)	0.6	16.5 (13.0)	0.25	0.41
Sugar (g)						
Move	11.1 (15.2)	11.5 (13.4)	0.79	11.7 (13.6)	0.1	0.95
Stand	11.4 (18.8)	9.15 (12.3)	0.16	8.37 (9.25)	0.21	0.24
Iron (mg)						
Move	0.86 (1.35)	0.75 (1.24)	0.6	0.84 (1.73)	0.06	0.52
Stand	0.94 (1.67)	0.75 (0.91)	0.97	0.67 (0.68)	0.44	0.25
Vitamin D (mcg)						
Move	0.15 (0.52)	0.14 (0.51)	0.79	0.25 (0.76)	0.27	0.95
Stand	0.18 (0.68)	0.05 (0.16)	0.36	0.13 (0.49)	0.75	0.57
Cholesterol (mg)						
Move	7.32 (21.0)	9.46 (25.6)	0.86	9.31 (41.2)	0.44	0.7
Stand	5.01 (11.6)	5.78 (16.6)	0.58	7.01 (21.6)	0.72	0.35

[1]Wilcoxon Signed Rank to compare baseline to 3 months.

[2] Wilcoxon Signed Rank to compare baseline to 12 months.

[3] Wilcoxon Signed Rank to compare 3 months to 12 months.

Table 5: Linear Mixed Model Analysis of Stand+ and Move+ Groups Excluding Plain Water

Mean Outcomes Move+ and Stand+ Groups Excluding Plain Water						
	Kcal		Protein		Total Fat	
	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value
Intervention Group						
Move	REF		REF		REF	
Stand	1.03 (0.75, 1.14)	0.86	1.11 (0.71, 1.72)	0.65	1.52 (0.89, 2.56)	0.11
Time Point						
0	REF		REF		REF	
3	0.95 (0.68, 1.33)	0.79	0.83 (0.53, 1.30)	0.41	0.80 (0.46, 1.41)	0.44
12	0.88 (0.62, 1.25)	0.49	0.74 (0.47, 1.19)	0.21	0.75 (0.41, 1.38)	0.36
	Carbohydrates		Sugar		Iron	
	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value	exp(Beta) (95% CI)	P-value
Intervention Group						
Move	REF		REF		REF	
Stand	0.99 (0.69, 1.41)	0.97	1.04 (0.63, 1.71)	0.87	1.21 (0.84, 1.73)	0.29
Time Point						
0	REF		REF		REF	
3	1.31 (0.89, 1.93)	0.16	0.99 (0.56, 1.76)	0.98	1.21 (0.79, 1.83)	0.38
12	0.84 (0.56, 1.26)	0.41	0.98 (0.52, 1.86)	0.97	0.88 (0.57, 1.37)	0.58
	Vitamin D		Cholesterol			
	exp(Beta) (95% CI)	P-value	exp(Beta) 95% CI)	P-value		
Intervention Group						
Move	REF		REF			
Stand	1.19 (0.48, 2.93)	0.71	0.96 (0.47, 1.96)	0.92		
Time Point						
0	REF		REF			
3	1.75 (0.56, 5.51)	0.33	1.47 (0.61, 3.56)	0.38		
12	0.95 (0.38, 2.40)	0.92	0.73 (0.32, 1.67)	0.46		

Discussion

There have been very few studies done to analyze the impact of sedentary interventions in the workplace on diet, especially snacking. Furthermore, with the increase in snack consumption over recent years there is still little data available about snack purchasing, behavior, and contribution to nutritional intake. The increase in consumption and calories of snacks could be contributing to the obesity epidemic and is therefore important to gain more information on snacking. The goal of this study was to begin to shed light on snacking behaviors in the workplace as well as the impact of sedentary interventions on snacking.

According to the U.S. Bureau of Labor Statistics, the median age of men and women in the workplace in 2016 was 41.9 for men and 42 for women, which is similar the average age of participants in this study.[13] The participation of women in the workplace is estimated to be 56.7% compared to 69.2% male participation.[13] In our study our results over represented males. Data from the government also reveals that the majority of the labor force in the United States is Caucasian (78%) followed by African Americans (13%) and Asians (6%).[13] Our study found a similar percentage of Caucasians in the workplace at 78.2% in the Move+ group and 70.3% in the Stand+ group.

According to the Census Bureau, the median household income for U.S. households was $57,617 in 2016.[14] The median household income for the states being represented for this study was $52,062 for Arizona and $64,188 for Minnesota.[14] The average income of the participants was higher than the average American and this could have an impact on their snack options/availability. In a large study conducted in France, data revealed that low income individuals were more likely to have snacks with lower nutrient density and higher energy content than those of higher socioeconomic class.[15] Due to the higher income of our participants, the average kilocalories of snacks could be underestimated compared to the general population whereas the nutritional value could be overestimated.

The most common location for snacking was at home followed by at work for both groups. This finding supports data collected by the U.S. Department of Agriculture's Food Acquisition and Purchasing Survey, which found that among 5222 working adults surveyed 22% of them got food and beverages from work at least once a week.[17] This added to an additional 1277 calories per week.[17] One may predict this pattern occurred in our study due to the convenience of snacks available in these locations. McGill and Appleton reported that convenience of obtaining the snack was an important attribute to consumers when making a snack purchase.[16] Therefore, the location of snacking could be influenced by the availability of snacks such as availability at home or work.

Another important aspect of the ASA 24 data was analyzing the macronutrient values of snacks in the Move+ vs Stand+ groups and possible impact of these interventions. From the data collected, there was almost consistently no significant difference between the Move+ vs Stand+ group between each macronutrient value as well as kilocalories over time when including and excluding plain water. Statistical significance was found when comparing the kilocalories of the Move+ group between 3 months and 12 months for snacks excluding plain water, however the total increase in kilocalories was very small over this time and unlikely to affect health or weight. There was also a statistically significant decrease in total fat by 0.66 g between 3 months and 12 months in the Move+ group for snacks excluding plain water. It is difficult to determine the significance of this decrease or why the decrease occurred.

Although the Move+ vs Stand+ interventions did not cause a large shift in snacking habits of the participants, the macronutrient data allows us to dive deeper into how snacks contribute to total daily kilocalories and recommended daily intake of nutrients. A large goal of this discussion is to reveal how this data can give more information on the impact of snacking on overall diet.

Our data confirms that snacking can contribute significant kilocalories to an individuals' diet. The average kilocalories per snacks including plain water were 122.96 kcal for the Move+ group and 121.36 kcal for the Stand+ group. The average kilocalories per snacks excluding plain water were 147.73 kcal for the Move+ group and 146.77 kcal for the Stand+ group. The 2009-

2012 NHANES snacking data revealed that Americans eat around 2.2 snacks per day and were consuming over 500 kilocalories/day from snacks.[18] With using an average of 2.2 snacks per day, our study participants were consuming between 267.01 kcals to 322.89 kcals per day just from snacks. The overall kilocalories consumed from snacks for our participants was lower than the national average from the NHANES 2009-2012 survey. Our participants were undergoing sedentary interventions Move+ and Stand+ and these interventions may have impacted their snack choices. The type of snacks available at their home or workplace may have also impacted the nutrient values.

Beyond kilocalories, our data allowed us to analyze the participants' daily intake of macronutrients from snacks. The Recommended Dietary Allowance (RDA) for nutrients varies based on sex for protein intake. The recommended amount of protein for males over 18 is 56 g/day and females over 18 is 46 g/day.[19] The protein intake from snacks for the Move+ group accounted for around 5.57% of recommended daily protein intake using the male RDA and 6.78% of using the female RDA. The protein intake from snacks for the Stand+ group accounted for around 5.89% of recommended daily protein intake using the male RDA and 7.17% of using the female RDA.

The RDA for Total Fat varies based on polyunsaturated fatty acids versus saturated and trans fatty acids.[19] Our data only collected total fat values and therefore comparison to RDAs could not be made. The RDA for carbohydrates for males and females is 130 g/day.[19] For snacks including plain water, carbohydrate intake contributed to 12.51% of daily intake for the Move+ group and 11.79% of daily intake for the Stand+ group. For snacks excluding plain water, the mean carbohydrate values of snacks contributed to 15.05% of daily intake for the Move+ group and 14.28% of daily intake for the Stand+ group. Overall, the RDA calculations for macronutrients of snacks excluding plain water were consistently higher than RDA calculations including plain water for the Move+ and Stand+ groups.

Besides macronutrients, this study evaluated several micronutrients including iron and vitamin D as well as sugar and cholesterol. There was no significant difference over time in these nutrients between the Move+ and Stand+ groups, however our data allows us to analyze the daily contribution of snacks to daily intake. Iron and Vitamin D are two of the most common vitamin deficiencies in the United States.[20] In fact, 9.5% of Americans are iron deficient and 8.1% of Americans are vitamin D deficient.[20] The RDA for iron is 8 mg/day in males and 18 mg/day in females.[19] Using the averages of iron intake per snack, the iron content of snacks for the Move+ and Stand+ groups contributed to 8%-10% of iron RDA in males and 3%-5% of iron RDA for females. The RDA for Vitamin D is 15 mcg/day for males and females. The snacks of the Move+ and Stand+ groups contributed between 0.67%-1.2% of Vitamin D RDA, which reveals snacks had little contribution to Vitamin D levels.

The World Health Organization recommends sugar intake to account for only 10% of an individuals' daily calorie intake.[21] This means that for someone with a normal BMI the recommendation is 25 g of sugar per day.[21] On average, one snack for the Move+ and Stand+ group contributed to slightly over 38% of the daily recommended sugar intake. Our data revealed that snacks contained high levels of sugar and participants were consuming almost half of the recommended daily intake in just one snack. Highly processed snack foods typically contain high sugar content and therefore our participants may have had more access to these types of foods. In fact, some of the most commonly recorded foods consumed by participants included cookies, popcorn, and ice cream.

It is important to also discuss how sedentary interventions impact workers beyond dietary habits. One report analyzing over 46 studies on standing desks showed that the average difference in calories burned between sitting and standing was 0.15 kcal/minute.[21] The goal of our study was for participants in the Stand+ group to stand for at least half the workday so an average participant could have burned almost 50 kcal/day extra by standing for at least half of their workday. Over time, this increased energy expenditure could decrease weight as well as well as combat sedentary behaviors in the workplace. It could also help balance out increased kilocalories being consumed by snacks each day.

Strengths and Limitations

There were several strengths for this study. The study includes a large sample size with over 250 participants in the Move+ and Stand+ groups. This study allowed us to study the impact of sedentary interventions on snacking habits as well as the contribution of snacks to recommended daily intake of each nutrient. Furthermore this study is one of the largest and only studies to analyze snacking in workers and is a great framework for future studies.

In regards to limitations, there were several demographics found to be different between the Move+ and Stand+ group, including age, gender, race, and educational levels. For future studies, recruitment tactics to further control these demographic factors should be implemented to limit variations between the groups. Another difficulty with the study design was the intricacy and length of the ASA 24 dietary recall. Participants did not just answer questions about snacking but also each meal of the day. Due to length of the recall, some participants may not have reported all their snacks in a day. Lastly, the 24 hour recall relies on participant memory of meals consumed the day prior and this may not be the most reliable source of true dietary intake.

Future Directions

This study was one of the first to analyze the impact of increasing low physical activity and reducing sitting in the workforce through sedentary interventions on snacking. Although the sedentary interventions had minimal influence on snacking, this project provides important insight into snacking habits and promotes healthier, more active lifestyles in the workplace. I believe that incorporating nutritional education as well as sedentary interventions into workplaces throughout Arizona and the nation is the next step of this project.

The Center of Disease Control and Prevention has stated that the use of effective workplace programs and policies can reduce health risks and improve quality of life for American workers.[23] Although the CDC Health Resources lists several handouts for worksites to become healthier, it does not offer any sedentary interventions as extensive as the ones in this study. I think that launching a future project to create an email-based sedentary intervention program that could be applied to a broad range of offices with seat-focused work would be the next step. The program could begin with sending out weekly tips, advice, and educational material similar to the individual-based interventions in the Move+ and Stand+ groups to encourage increased light physical activity in the day such as walking the stairs and at-desk workouts. The emails could also contain nutritional tips such as healthier snack options with lower calories and high nutrients. The goal of the program would be application in multiple sites in Arizona and then opening the program to the nation.

Conclusions

With the growing obesity epidemic, there is growing importance in identifying the impact of dietary habits such as snacking on weight status. By analyzing snacks including and excluding plain water, the study is one of the beginning steps to identify the impact of snacking in the workplace as well as the effect of sedentary interventions on snacking. The results of the study have identified that sedentary interventions Move+ vs Stand+ mostly had no significant impact on snacking in the worksites studied over time. There was a significant difference in kilocalories and total fat between Move+ timepoints 3 months and 12 months in snacks excluding plain water. The health impact, however, is very small. Our data confirmed that snacking can add significant kilocalories to an individuals' daily diet, especially with multiple snacks being consumed each day by the average person. When analyzing Recommended Dietary Allowance values, each snack contributed between 5%-15% to protein and carbohydrate daily RDAs in the Move+ and Stand+ groups. Snacks were also found to contribute to iron intake, but were low in Vitamin D. Snacks consumed had high sugar content, with each snack containing around 38% of the daily recommended sugar intake. Although the sedentary interventions did not significantly impact snacking over time, these interventions do have the potential to burn a significant amount of calories over time as well as fight sedentary behaviors. Overall, this study provides needed data on snacking patterns in the American workforce. With very little studies like this, this report can serve as a framework for future studies to help collect more data on snacking patterns. Further studies are still needed to determine the drive behind snacking behaviors as well as the impact of sedentary interventions on dietary habits.

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